

2 Chemistry of the elements

Using the Periodic Table

Question	Answers and guidance	Marks
1 a)	N and L	1
b)	K	1
c)	1^-	1
d)	M It is a noble gas/it has a full outer electron shell	1 1
Total		5

Question	Answers and guidance	Marks
2 a)	A, B or D	1
b)	A	1
c)	D	1
d)	C and E	1
e)	2, 8, 6	1
f)	Oxygen	1
Total		6

Question	Answers and guidance	Marks
3 a)	Any Group 4 element, e.g. carbon or silicon	1
b)	Strontium, barium or radium	1
c)	Phosphorus	1
d)	Argon has a full outer shell of electrons	1
e)	A calcium ion has lost the two outer electrons the ion has got 18 electrons which is the same as argon	1 1
Total		6

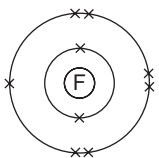
Question	Answers and guidance	Marks
4 a)	The pH decreases across the period pH starts high/alkali for metals pH is lower/acid for non-metals	1 1 1
b)	They are insoluble	1
c)	Dissolve the oxide in water If it has a pH of less than 7 it is a non-metal	1 1
d) i)	2 or 3	1
ii)	2 or 3	1
iii)	14	1
iv)	8–14 OR it may not dissolve	1
Total		10

Question	Answers and guidance	Marks
5 a) i)	Metals	1
ii)	Any other named metal	1
iii)	Non-metal	1
iv)	Any other named non-metal	1
b) i)	Metals	1
ii)	Any other named metal	1
Total		6

Using electronic configurations

Question	Answers and guidance	Marks
1 a)	2, 8, 1	1
b)	Floats on water's surface Fizzes/makes bubbles/gas produced Turns into ball/sphere Slowly gets smaller	1 1 1 1
c)	$2\text{Na(s)} + 2\text{H}_2\text{O(l)} \rightarrow 2\text{NaOH(aq)} + \text{H}_2\text{(g)}$	1
d)	Distance from outer electron to nucleus increases down the group This means the outer electron is not as strongly attracted to the (positive) nucleus/there is a greater shielding effect from the shells So the electron is lost more easily	1 1 1
Total		9

Question	Answers and guidance	Marks
2 a)	2, 1	1
b)	Lithium is least reactive Potassium is most reactive	1 1
c)	As the atomic number increases, the relative distance increases	1
d)	More reactive than potassium	1
e)	Distance from outer electron to nucleus increases down the group This means the outer electron is not as strongly attracted to the (positive) nucleus/there is a greater shielding effect from the shells So the electron is lost more easily	1 1 1
Total		8

Question	Answers and guidance	Marks
3 a)	 <p>1 mark for 2 electrons on first shell 1 mark for 7 electrons on second shell</p>	2
b) i)	7	1
ii)	7	1
c) i)	chlorine	1
ii)	bromine	1
iii)	Group 7 elements are more reactive higher up the group	1
Total		7

Question	Answers and guidance	Marks
4 a)	Chlorine reacts with sodium bromide to make bromine	1
b)	$\text{Cl}_2(\text{g}) + 2\text{Br}^-(\text{aq}) \rightarrow 2\text{Cl}^-(\text{aq}) + \text{Br}_2(\text{aq})$ 1 mark for correct ions; 1 mark for balancing	2
c) i)	2, 8, 7	1
ii)	2, 8, 8	1
d)	The chlorine atoms remove an electron from the bromine ions turning the chlorine atoms into chloride ions and leaving bromine atoms	1 1
Total		7

Question	Answers and guidance	Marks
5 a)	$\begin{array}{c} \times \times \\ \text{H} \quad \bullet \quad \text{Cl} \quad \times \\ \times \quad \times \quad \times \\ \times \times \end{array}$ 1 mark for 7 outer electrons for chlorine 1 mark for showing covalent bond with hydrogen	2
b)	$\text{HCl}(\text{g}) \rightarrow \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$	2
c) i)	Hydrogen atom loses its electron to the chlorine atom	1
ii)	The chlorine atom gains the hydrogen's electron becoming 2, 8, 8	1
d)	The hydrogen chloride has no electrons free to move Hydrochloric acid separates into charged ions These ions are free to move carrying the electric current	1 1 1
Total		9

Question	Answers and guidance				Marks
6 a)					
	Element	Appearance at room temperature	Electronic configuration of the atom	Electronic configuration of the ion.	
	lithium	dull grey solid	2, 1	2	1
	fluorine	colourless gas	2, 7	2, 8	1
	sodium	light grey solid	2, 8, 1	2, 8	1
	chlorine	green gas	2, 8, 7	2, 8, 8	1
	potassium	dark grey solid	2, 8, 8, 1	2, 8, 8	1
1 mark for each correct line					
b)	The sodium atom loses an electron to achieve the electronic configuration of neon The fluorine atom gains an electron to achieve the electronic configuration of neon				1 1
c)	Distance from outer electron to nucleus is greater in potassium than lithium				1
	This means the outer electron is not as strongly attracted to the (positive) nucleus/there is a greater shielding effect from the shells for potassium				1
	So the potassium's outer electron is lost more easily making it more reactive				1
Total					10

Charges, chemical formulae and equations

Question	Answers	Marks
1 a)	$2\text{Cu(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{CuO(s)}$ 1 mark for formulae; 1 mark for balancing	2
b)	$\frac{(100 - 79)}{100} \times 100$ = 21%	1 1
c)	Oxidation	1
d)	It loses two electrons	1
Total		6

Question	Answers and guidance	Marks
2 a)	$2\text{Mg(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{MgO(s)}$ 1 mark for formulae; 1 mark for balancing	2
b)	Oxidation	1
c)	It gains two electrons	1
d) i)	$2\text{Mg(s)} + \text{CO}_2\text{(g)} \rightarrow 2\text{MgO(s)} + \text{C(s)}$ 1 mark for formulae; 1 mark for balancing	2
ii)	Carbon	1
iii)	Reduction	1
Total		8

Question	Answers and guidance	Marks
3 a)	2^-	1
b)	$\text{S(s)} + \text{O}_2\text{(g)} \rightarrow \text{SO}_2\text{(g)}$ 1 mark for formulae; 1 mark for balancing	2
c)	Oxidation	1
d)	It reacts with water in the air producing acid rain which is harmful to plants and wildlife/rocks or named building materials	1 1
Total		6

Question	Answers and guidance	Marks
4 a)	$4\text{Fe(s)} + 3\text{O}_2\text{(g)} \rightarrow 2\text{Fe}_2\text{O}_3\text{(s)}$ 1 mark for formulae; 1 mark for balancing	2
b)	3^+	1
c)	$\frac{(50 - 40)}{50} \times 100$ = 20%	1 1
d)	Oxidation	1
e)	2^+	1
f)	It loses two electrons	1
Total		8

Question	Answers and guidance	Marks
5 a)	Carbon dioxide	1
b)	It is a greenhouse gas that may cause global warming	1 1
c)	$\text{ZnCO}_3(\text{s}) \rightarrow \text{ZnO}(\text{s}) + \text{CO}_2(\text{g})$ 1 mark for formulae; 1 mark for balancing	2
d) i)	Carbon dioxide	1
ii)	Reduction	1
iii)	Redox	1
Total		8

Question	Answers and guidance		Marks
6 a)	gas	percentage in air	1 1 1
	oxygen	21	
	nitrogen	79	
	carbon dioxide	value between 0.03 and 0.05	
	argon	0.93	
	water vapour	variable	
b)	Any two ideas for 1 mark each from: <ul style="list-style-type: none">• it depends on the amount of rain• deserts are dry areas• over oceans/seas/lakes there will be more water vapour		2
c) i)	2Mg(s) + O ₂ (g) → 2MgO(s) 1 mark for formulae; 1 mark for balancing		2
ii)	Magnesium		1
Total			8

Practical work 1

Question	Answers and guidance	Marks
1 a)	Description linking five of the following points, for 1 mark each: <ul style="list-style-type: none"> set up test tubes containing different stone samples in acid rain solution control tube with marble in pure/distilled/pH 7 water same mass/surface area of each stone leave tubes for same length of time/at same temperature method to measure corrosion, e.g. change in mass/surface area repeat experiment/obtain more results from others or by second set of equipment 	5
b)	Bubble gas through limewater It will turn cloudy white if it is carbon dioxide	1 1
Total		7

Question	Answers and guidance	Marks
2 a)	Copper carbonate It produced most carbon dioxide in the time	1 1
b)	Keep the flame size/heat supplied the same for all the trials Use the same amount/mass/number of moles of the carbonate	1 1
c)	After heating water can rise back into the tube as the test tube cools The end of the tube should be removed from the water before stopping heating	1 1
Total		6

Question	Answers and guidance	Marks
3 a)	Put a lit candle/flame in a beaker	1
	Pour carbon dioxide gas into the beaker	1
	The flame will go out as the beaker fills from the bottom	1
	proving the carbon dioxide is heavier than air	1
	OR	
	Fill a gas jar with carbon dioxide and place it above a gas jar of air	1
	Leave for a minute the test for carbon dioxide with a lighted spill	1
	The spill will go out in the bottom gas jar, but stay alight in the top jar proving the carbon dioxide is heavier than air	1
b)	$\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$ 1 mark for formulae of products; 1 mark for balancing	2
Total		6

Question	Answers and guidance	Marks
4 a)	Description linking five of the following points for 1 mark each: <ul style="list-style-type: none"> • set up test tubes containing different metal samples in acid rain solution • same mass/surface area of each metal • leave tubes for same length of time/at same temperature • method to measure corrosion, e.g. change in mass/surface area • method to establish reactivity of metal, e.g. most reactive metal will have lost most mass. • repeat experiment/obtain more results from others or by second set of equipment 	5
b)	Find the rainwater's boiling point If it is not 100 °C then it is not pure water	1 1
Total		7

Question	Answers				Marks
5 a)	2 marks for a correct row, 1 mark for 2 right in a row.				6
	Element	Observations during reaction	pH of aqueous solution of oxide	Is the oxide an acid or a base?	
	calcium	burns with a red glow	13	base	
	carbon	burns with a red glow	5	acid	
	magnesium	burns with white light	12	base	
	sulfur	burns with purple/ blue flame	1	acid	
b)	Metals produce basic oxides Non-metals produce acidic oxides				1 1
c)	Add the liquid to anhydrous copper sulfate If the liquid contains water the anhydrous copper sulfate will turn blue				1 1
d)	Find the liquid's boiling point If it is not 100 °C then it is not pure water				1 1
Total					12

Practical work 2

Question	Answers and guidance	Marks
1 a)	Calcium	1
b)	Add some dilute nitric acid Followed by silver nitrate solution A white precipitate will form	1 1 1
c)	Add some dilute hydrochloric acid Followed by barium chloride solution A white precipitate will form	1 1 1
d)	CaSO ₄	1
Total		8

Question	Answers and guidance	Mark
2 a)	Add some dilute hydrochloric acid It will produce a gas that should be bubbled through limewater to prove its carbon dioxide	1 1 1
b)	Add some dilute sodium hydroxide solution Heat gently to release ammonia gas Prove the gas is ammonia by turning damp red litmus/universal indicator paper blue	1 1 1
c)	$[(14 + 1 + 1 + 1 + 1) \times 2] + 12 + 16 + 16 + 16$ = 96	1 1
Total		8

Question	Answers and guidance	Marks
3 a)	Add sodium hydroxide solution A blue precipitate will form if copper is present	1 1
b)	Add some dilute hydrochloric acid followed by barium chloride solution A white precipitate will form	1 1 1
c)	The green colour from the copper ions will mask the brick red colour of the calcium	1 1
Total		7

Question	Answers and guidance	Marks
4 a)	Add some dilute nitric acid followed by silver nitrate solution A cream precipitate will form	1 1 1
b)	Dip a clean (nichrome) wire into the solution Put it into a roaring Bunsen flame It should produce a lilac/purple colour in the flame	1 1 1
c)	The precipitate will be yellow not cream	1
Total		7

Question	Answers and guidance	Marks
5 a)	Place a piece of damp red litmus/universal indicator in a sample of the gas The chlorine will bleach the paper The ammonia will turn it blue	1 1 1
b)	Put a glowing spill into the gas. It will re-light if the gas is oxygen	1
c)	Put a burning spill into the gas. It will 'pop' if it is hydrogen	1
Total		5

Question	Answers and guidance	Marks
6 a)	Add sodium hydroxide solution A brown precipitate will form if iron(III) is present	1 1
b)	Dissolve some of the solid in water Add sodium hydroxide solution A green precipitate will form if iron(II) is present	1 1 1
c)	Fe^{3+} has 1 less electron	1
Total		6

Data analysis

Question	Answers and guidance	Marks
1 a)	Put a burning spill into the gas It will 'pop' if it is hydrogen	1
b)	D, B, C, E, A 1 mark for each correctly placed metal to a maximum of 4	4
c)	A	1
Total		6

Question	Answers and guidance	Marks
2 a)	The reaction is not possible	1
b)	Displacement	1
c)	Magnesium It reacts with the other three metal solutions	1 1
d)	Copper It doesn't react with any of the solutions	1 1
e)	$\text{Mg(s)} + \text{FeSO}_4\text{(aq)} \rightarrow \text{MgSO}_4\text{(aq)} + \text{Fe(s)}$ 1 mark for correct equation; 1 mark for correct state symbols	2
Total		8

Question	Answers and guidance	Marks
3 a)	Sodium iodide	1
b)	None	1
c)	Chlorine, bromine, iodine	1
d)	Chlorine (water) + sodium bromide \rightarrow bromine (water) + sodium chloride	1
e)	$\text{Cl}_2\text{(aq)} + 2\text{I}^-\text{(aq)} \rightarrow \text{I}_2\text{(aq)} + 2\text{Cl}^-\text{(aq)}$ 1 mark for correct formulae; 1 mark for correct balancing	2
f)	The bromine atoms become ions by taking the extra electrons from the iodide ions making them into iodine atoms	1 1
Total		8

Question	Answers and guidance	Marks
4 a)	$2\text{Al(s)} + \text{Fe}_2\text{O}_3\text{(s)} \rightarrow 2\text{Fe(s)} + \text{Al}_2\text{O}_3\text{(s)}$ 1 mark for correct formulae; 1 mark for correct balancing	2
b) i)	Aluminium	1
ii)	Iron oxide	1
c) i)	Sodium, aluminium, zinc, copper 1 mark for each correctly placed metal to a maximum of 3	3
ii)	Whether iron is more reactive than zinc or copper	1
iii)	We know iron is less reactive than aluminium, but need to find out if it is above or below zinc or copper	1
Total		9

Question	Answers	Marks
5 a) i)	reactivity increases down the group for both groups	1 1
ii)	$2\text{Li(s)} + 2\text{H}_2\text{O(l)} \rightarrow 2\text{LiOH(aq)} + \text{H}_2\text{(g)}$ 1 mark for correct formulae; 1 mark for correct balancing	2
b) i)	All of them would have reacted with the water in the solution except beryllium.	1
ii)	Potassium, sodium, lithium, calcium, magnesium, beryllium. 1 mark for each correctly placed metal to a maximum of 5	5
iii)	$2\text{Li(s)} + \text{MgO(s)} \rightarrow \text{Li}_2\text{O(s)} + \text{Mg(s)}$ 1 mark for correct formulae; 1 mark for correct balancing	1 1
iv)	Magnesium oxide It has gained electrons/lost oxygen	1 1
Total		14

Longer-answer questions

Question	Answers and guidance	Marks
1	The following points, for 1 mark each: <ul style="list-style-type: none"> manganese(IV) oxide should be placed in the bottom of the flask hydrogen peroxide solution should be added through the tap funnel the first gas jar of gas collected will not be pure it will contain air from the apparatus so it should be discarded later gas jars will be pure 	1 1 1 1 1 1
Total		6

Question	Answers and guidance	Marks
2	1 mark for an advantage for each method; 1 mark for a disadvantage for each method <i>Using grease</i> Advantage: easy to apply Disadvantage: wipes off metal <i>Paint</i> Advantage: cheap/easy to apply Disadvantage: needs replacing when damaged <i>Galvanising</i> Advantage: needs no replacing/hard to damage Disadvantage: high cost of zinc 1 mark for a concluding statement giving preference with reason(s)	 1 1 1 1 1 1 1
Total		7

Question	Answers and guidance	Marks
3	Sulfate test	
	• dissolve a little of the crystals in water in a test tube	1
	• add barium chloride solution and dilute hydrochloric acid/barium nitrate solution and dilute nitric acid	1
	• you will get a white precipitate/gel/solid in the test tube	1
	Potassium test	
	• dip a (nichrome) wire into some concentrated hydrochloric acid then into the potassium sulfate crystals	1
Total	• put the coated wire into a roaring Bunsen flame	1
	• the flame should turn lilac/pink if potassium is present	1
Total		6

Question	Answers and guidance	Marks
4	The following points, for 1 mark each:	
	• as a gas the atoms are covalently bonded	1
	• dissolved in water the hydrogen chloride dissociates to the ions H^+ and Cl^-	1
	• the H^+ ions mean the solution will be acidic.	1
	• in methylbenzene the hydrogen chloride does not dissociate	1
	• so there are no H^+ ions so the solution is neutral	1
Total		5

Question	Answers and guidance	Marks
5	All three for 2 marks; any two for 1 mark	
	• tube 1 – both air and water	2
	• tube 2 – water only	
	• tube 3 – air only	
	All three for 2 marks; any two for 1 mark	
	The tubes compare the effect of	2
	• air by itself	
	• water by itself	
Total	• air and water together	
	• which allows the student to see if either air or water, or both cause rusting	1
	Rust will be present only in tube 1	1
Total		6